LEADER TEST INSTRUMENTS

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MODEL LPM-885

SWR / WATTMETER

INSTRUCTION MANUAL

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1 DESCRIPTION

1.1 GENERAL

The LPM-885 is a sensitive in-line type watt meter designed to measure the SWR of transmission lines and transmitter power output in the frequency bands 1.8 to 54MHz. Use is made of a toroidal coil with wideband characteristics for sensing the forward and reverse directions of power. The LPM-885 facilitates adjustment of transmitters and antenna systems for highest efficiency. The LPM-885 can be left in circuit for continuous monitoring of power output.

FEATURES

* Low power operating requirement, only 10W, for SWR measurements in the 1.8 and 3.5MHz bands.
* Power and SWR readings are indicated on a wide-scale meter.
* Power measurements maybe made over a wide range ; 1 to 1000W.
* Accurate SWR measurements are available using the ratio of the forward to reverse power.
* SWR/WATT detector unit assembly can be separated from the LPM-885 for "remote" measurements.
* Feed-through power metering eliminates power loss.

1.2 SPECIFICATIONS

Frequency Range ····· 1.8 – 54MHz.
Impedance ····· 50Ω.
Forward and
Reverse Power ····· Three ranges each: 20, 200, 1000W f.s.; accuracy: ±10% f.s. to 40MHz, and ±15% f.s. to 54MHz.

SWR Range ····· 1.0 – 10, direct reading.
SWR Power
Requirement ····· 10 – 500W.
Connectors ····· Type M (UHF), Input-Output.
Size and Weight ····· 150(H) X 112(W) X 125(D) mm; approx. 1.2kg.

1.3 CONTROL FUNCTIONS & CONNECTORS

A. Front panel, Fig. 1-1.

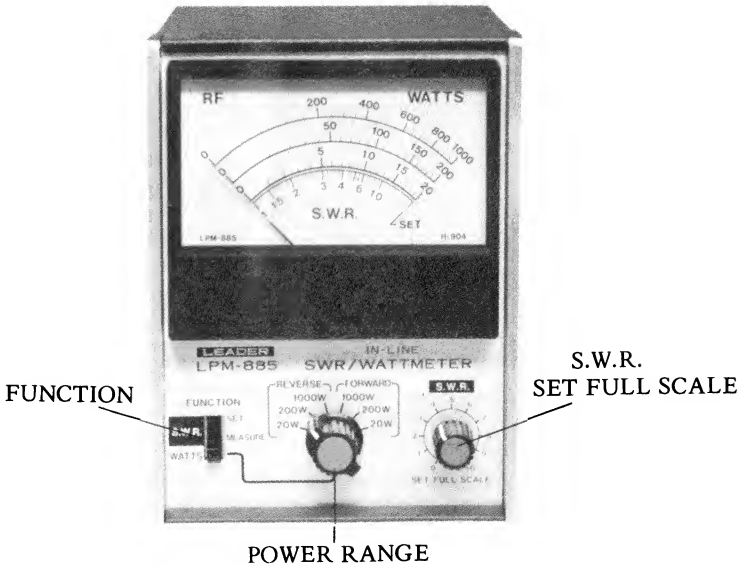


Fig. 1-1 Front panel functions.

Meter, with three scales calibrated for power in WATTS, and one scale for SWR, 1 – 10.

FUNCTION switch: This slide switch selects the modes of application.

* For SWR measurement, two positions are used, namely, SET and MEASURE.

* The WATTS position is used to measure power.

POWER RANGE: Selects the full scale ranges when measuring power in the forward and reverse (reflected or backward) directions.

SWR SET FULL SCALE control: Used when measuring the SWR; Sets the reference output power level.

B. Rear panel, Fig. 1-2.

Two coaxial cable connectors for connections to the transmitter output, TX, and antenna input, ANT.

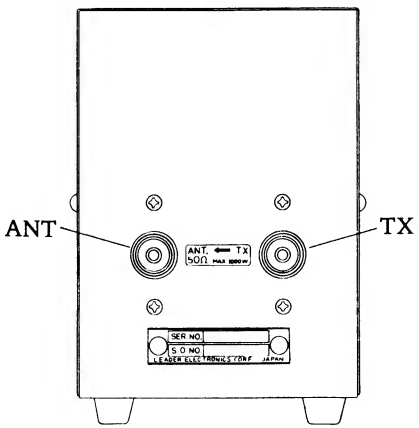


Fig. 1-2 Rear panel connectors.

2 OPERATION

2.1 Precautions in Use

1. The LPM-885 is specially designed for a characteristic impedance of 50Ω. Do not use with 75Ω or other impedances.
2. Do not disturb any internal adjustments.

2.2 Connections

The coaxial cable connections are made as shown in Fig. 2-1.

Transmitter output cable to the TX connector.

Antenna cable, or other load, to ANT connector.

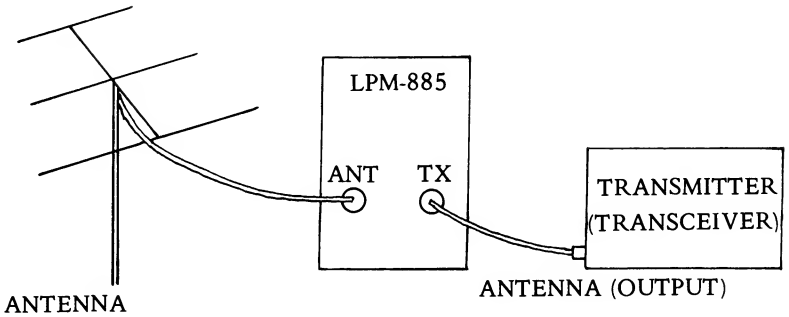


Fig. 2-1 Interconnections.

NOTES: a. Use only 50Ω (or 52Ω) cable for connections.

b. Take care that cablescare properly connected to the respective connectors as marked.

c. Make certain that the connectors are securely attached; loose connections will cause trouble.

2.3 Direct SWR Measurements

IMPORTANT – The transmitter output power must be in the 10 – 500W range; underloading or overloading will occur when outside these limits.

1. Initial settings:

   Function switch at SET position.

   SWR SET FULL SCALE control at midposition.

2. Turn on the transmitter power.
3. Adjust the SWR control for the "SET" reading on the lowest meter scale.
4. Set the function switch at MEASURE and read the SWR on the SWR scale.

NOTE: In the LPM-885, the SWR scale has been calibrated at 20W in the forward direction. Depending on the power level used in measurements, there will be a slight error in the SWR. This is due to the non-linearity of the diodes in the detecting circuit. Thus at higher powers the SWR will read high by a small amount and vice versa. This condition should not affect the results when making adjustments for the lowest SWR. (Use of the power level at, or near, 20W will minimize the error.)

2.4 Power Measurements

1. Control settings:

   Function switch at WATTS.

   Power switch at FORWARD 1000W, 200W or 20W depending on the output. If in doubt, set at 1000W and work down.

2. Read the forward power on the approriate meter scale.
3. When the power switch is set at the REVERSE ranges, the reverse (or reflected) power will be indicated. Properly matched impedances will show a very low reading.

NOTES: a. Corrections are required (due to the frequency characteristics in the detecting circuit) for power in the 30–54MHz range as follows:

Frequency Range	Multiply WATTS by –
30 – 40MHz	1.1
40 – 54MHz	1.25

b. Connection of a 50Ω dummy load (with proper power rating) to the ANT connector will make the LPM-885 a dummy load type wattmeter. In this case, the power switch is set at one of the FORWARD ranges.

2.5 SWR Measurements using Power Values

In addition to the method described in Sect. 2.3 for SWR measurements the SWR can be determined with the forward and reverse power values.

Two methods will be given.

Method 1: Use of the nomograph, Fig. 2-2.

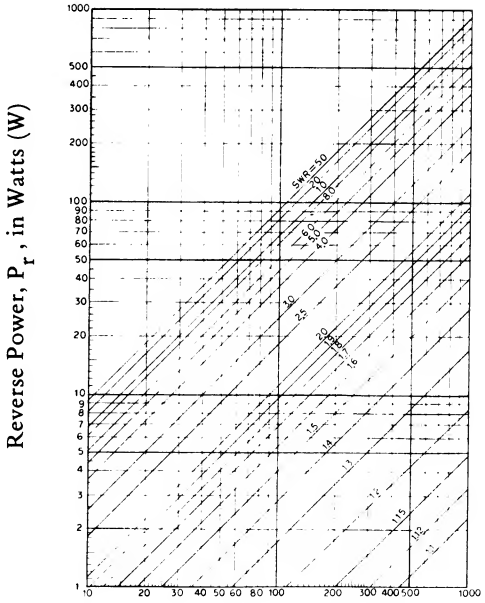


Fig. 2-2 SWR nomograph.

Example: Forward power, P_f = 100W
Reverse power, P_r = 4W
SWR = 1.5

Method 2: By calculation.

The SWR is calculated with the following relation –

$$SWR = \frac{1 + \sqrt{\frac{P_r}{P_f}}}{1 - \sqrt{\frac{P_r}{P_f}}}$$

where P_r = reverse power in watts

P_f = forward power in watts

If the ratio, $P_r : P_f$, is known, then the SWR can be conveniently determined by reference to TABLE 1.

TABLE 1
Conversion of Power Ratio to SWR

Power Ratio: $\frac{P_r}{P_f}$	SWR	Power Ratio: $\frac{P_r}{P_f}$	SWR
0.30	3.42	0.25	1.38
.25	3.00	.02	1.33
.20	2.62	.01	1.22
.184	2.50	.009	1.21
.15	2.26	.008	1.20
.11	2.00	.006	1.17
.10	1.93	.005	1.15
.09	1.86	.004	1.13
.08	1.8	.003	1.11
.07	1.72	.0023	1.10
.06	1.65	.002	1.09
.05	1.58	.001	1.06
.04	1.50	.0006	1.05

2.6 Effect of Loss in Coaxial Cable on SWR

In the SWR measurements outlined above, it has been assumed that there is no loss in the cable between the transmitter and antenna.

In practice, however, the actual SWR will depend on the type and length of the cable used. When connections are made as in Fig. 2-1, the measured SWR will be lower than the actual value.

Corrections can be made by referring to TABLE 2 and the curves in Fig. 2-3.

TABLE 2
Loss in Coaxial Cables, dB per 10 meters (33 feet)

Type	Frequency, MHz						
	1.8	3.5	7.0	14	21	28	50
3D2V	0.21	0.29	0.39	0.54	0.67	0.77	1.05
RG58/U	0.19	0.26	0.36	0.50	0.62	0.72	0.98
5D2V	0.11	0.16	0.21	0.31	0.38	0.45	0.61
RG8/U	0.08	0.11	0.16	0.23	0.29	0.34	0.51
8D2V	0.07	0.10	0.14	0.20	0.25	0.29	0.42
10D2V	0.06	0.09	0.12	0.16	0.20	0.23	0.33

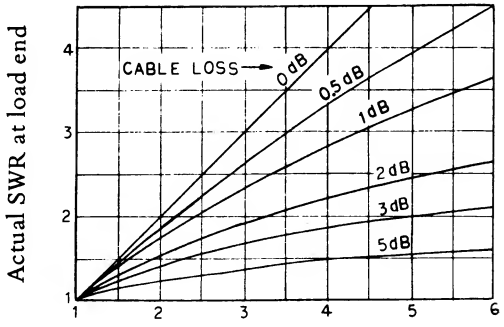


Fig. 2-3 Correction curves for cable loss.

Example: Assume that at 14MHz, the SWR as measured is 1.5 and the RG8/U cable length is 43.5 meters. From TABLE 2, for the RG8/U cable, the loss is 0.23dB per 10m. The loss is then 1dB (= 4.35 x 0.23). Then from Fig. 2-3. the actual SWR is 1.7 at 1dB cable loss and measured SWR of 1.5.

2.7 Detaching the Detector Unit

The detector unit (directional coupler) can be taken out of the case and remotely located for monitoring the output at other than the normal operating position.

To remove the unit, take off the cover of the meter by unscrewing two screws at the sides of the case.

Next, unsolder the three leads to the unit, see Fig. 2-4.

Remove the four screws which hold the unit to the back cover, and take out the unit.

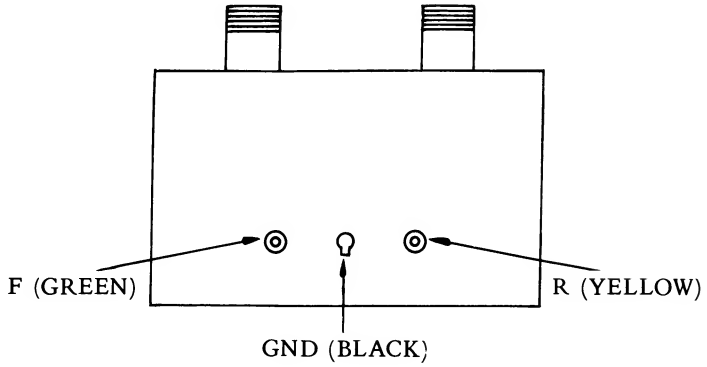


Fig. 2-4 Top view of the detector unit.

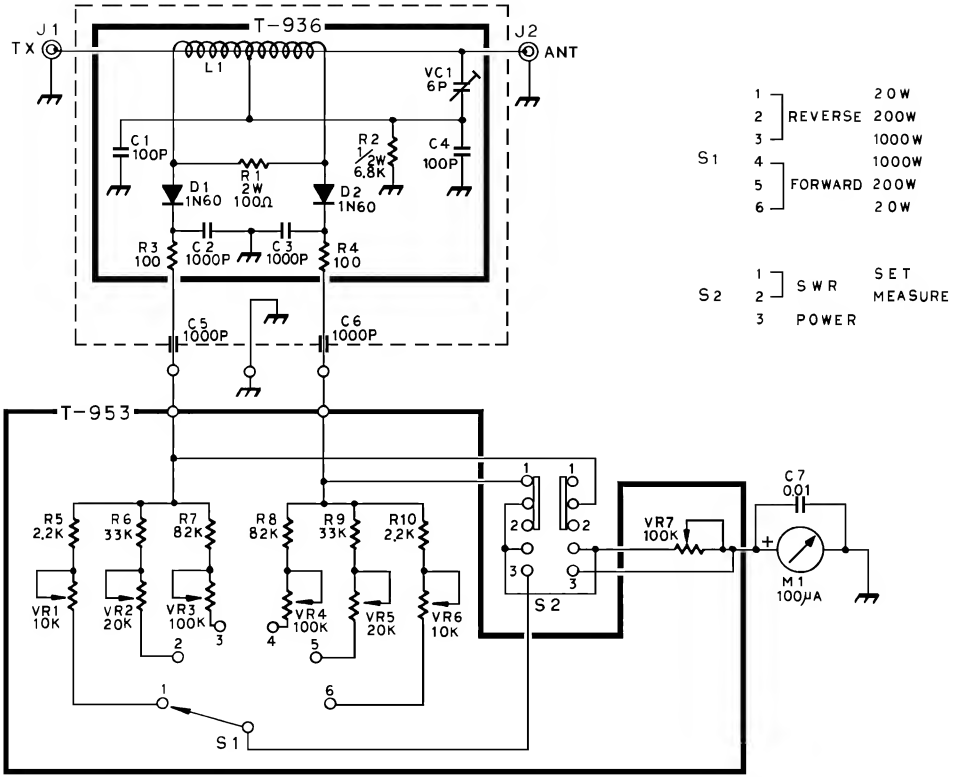
Connect three leads to the free ends of the unsoldered leads; the lead lengths depend on the distance to the installed location. These leads can be passed through one of the large holes on the back cover.

Restore the cover on the meter.

NOTES: a. Make certain that correct lead connections are properly made, green for the forward power, F, black for ground, and yellow for reverse power, R.

b. Since the unit is not waterproofed, it is necessary when installed outdoors to apply suitable means to keep out the moisture, dust, etc.

c. The four holding screws for the units should be replaced on the shield to prevent their loss.


T-936
J1
TX
J2
ANT
L1
VC1
6P
C1
100P
R1
2W
100Ω
R2
1/2W
6.8K
C4
100P
D1
1N60
D2
1N60
R3
100
C2
1000P
C3
1000P
R4
100
C5
1000P
C6
1000P
T-953
R5
2.2K
R6
33K
R7
82K
R8
82K
R9
33K
R10
2.2K
VR1
10K
VR2
20K
VR3
100K
VR4
100K
VR5
20K
VR6
10K
S1
S2
VR7
100K
C7
.001
M1
100μA
1
REVERSE
20W
2
200W
3
1000W
S1
4
1000W
FORWARD
5
200W
6
20W
S2
SWR
SET
MEASURE
POWER